

# VALIDATION OF THE TIMELINE AVHRR LAND SURFACE TEMPERATURE (LST) PRODUCT WITH MODIS AND IN SITU LST

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## The TIMELINE Project

The Advanced Very High Resolution Radiometer (**AVHRR**) is mounted on the platforms of the National Oceanic and Atmospheric Administration (NOAA) and Meteorological Operational Satellite (MetOp) and provides multispectral data since the early 1980s. The TIMELINE project aims at generating **long and homogenized time series** of geo-scientific variables from that data over **Europe and North Africa**. Among these, LST is a key variable describing climate change and land surface processes from local to global scales.

## The TIMELINE LST Product

TIMELINE LST is derived from AVHRR Top of Atmosphere (TOA) brightness temperatures. For AVHRR-1 the **Mono Window Algorithm** by [1] and for AVHRR-2 and AVHRR-3 the **Split Window Algorithm** by [2] is used.

The algorithms have been enhanced by [3] with additional parameters for each platform and level of Total Columnar Water Vapor (TCWV), Sensor Zenith Angle and LST.

The **emissivity** of the surface is dynamically derived from the GlobCover land cover classification [4] and the Fraction of Vegetation Cover (FVC) with the Vegetation Cover Method by [5]. From 1981 – 2015, 77286 L2 LST products have been generated.

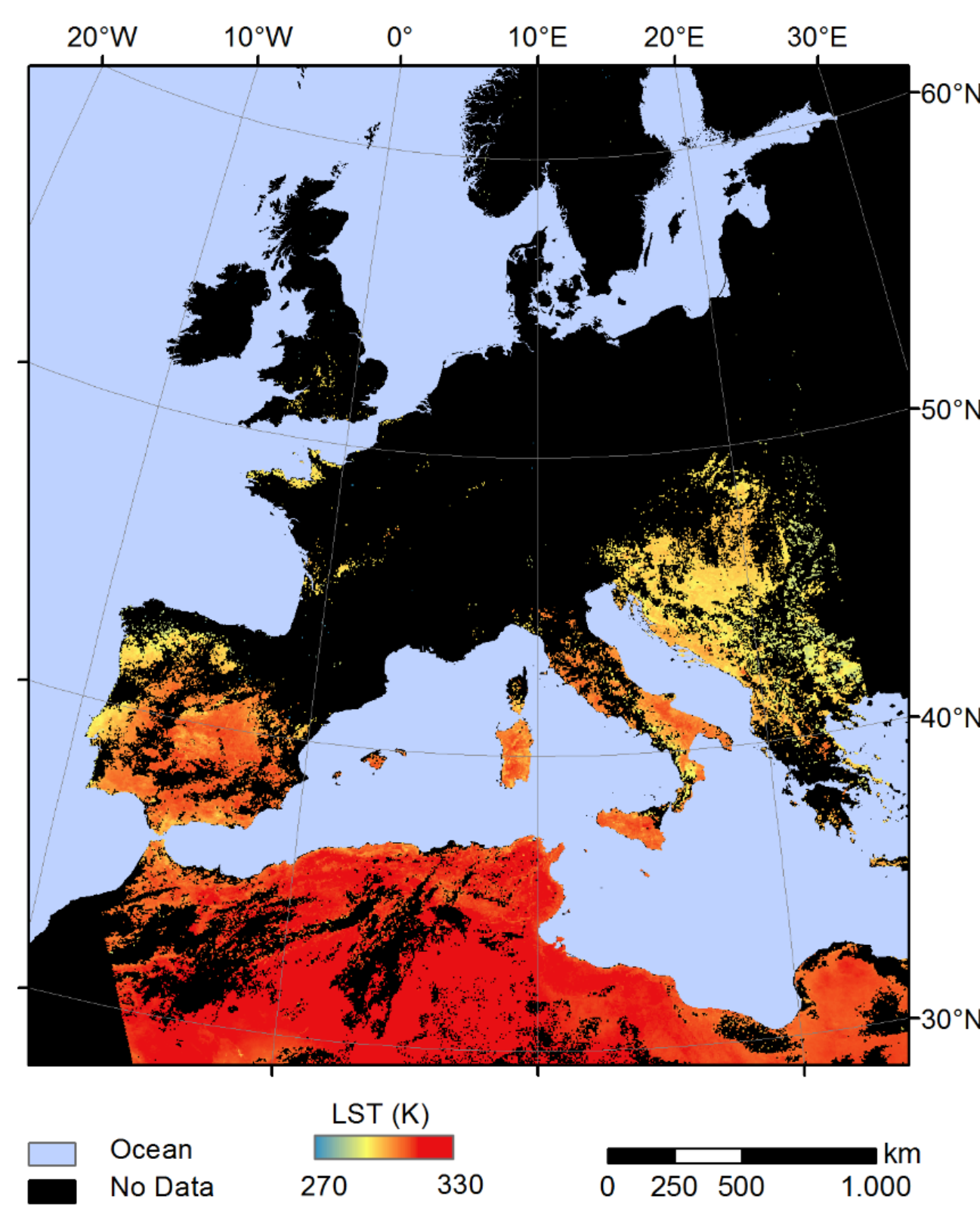


Fig. 1: TIMELINE LST on 02 August 2010

## Validation Data

**In situ** LST as well as the **MODIS** LST product (MOD11\_L2) have been used for validation. In situ LST was derived at eight SURFRAD measurement sites in the USA [6], two KIT sites in Namibia and Portugal [7] and one GCU site in Spain [8].

All spatial and temporal overlaps (max. acquisition time difference of 10 minutes) between TIMELINE and MODIS LST over North America and Southern Africa were investigated. TIMELINE LST was validated for the years 2010–2013. It was derived from AVHRR-3 data from the platforms NOAA-15, 16, 18 and 19.

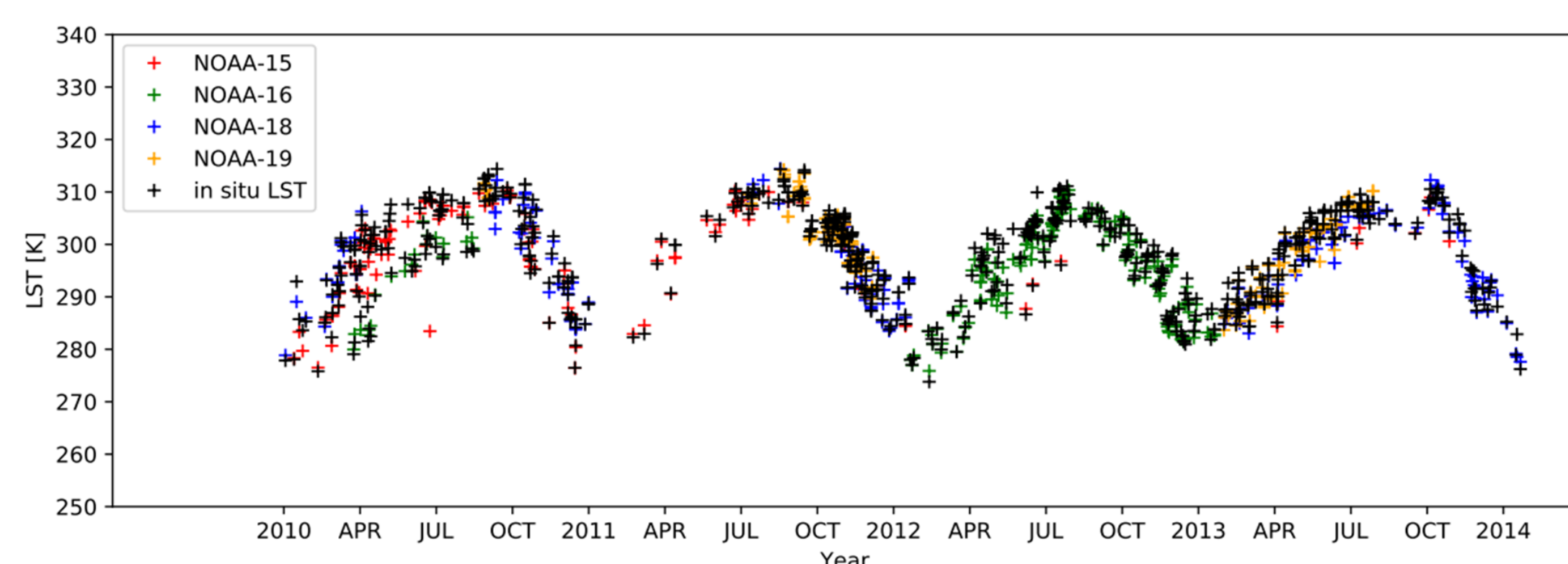


Fig. 2: TIMELINE LST by platform and in situ LST plotted against time at the SURFRAD station Goodwin Creek

## Results

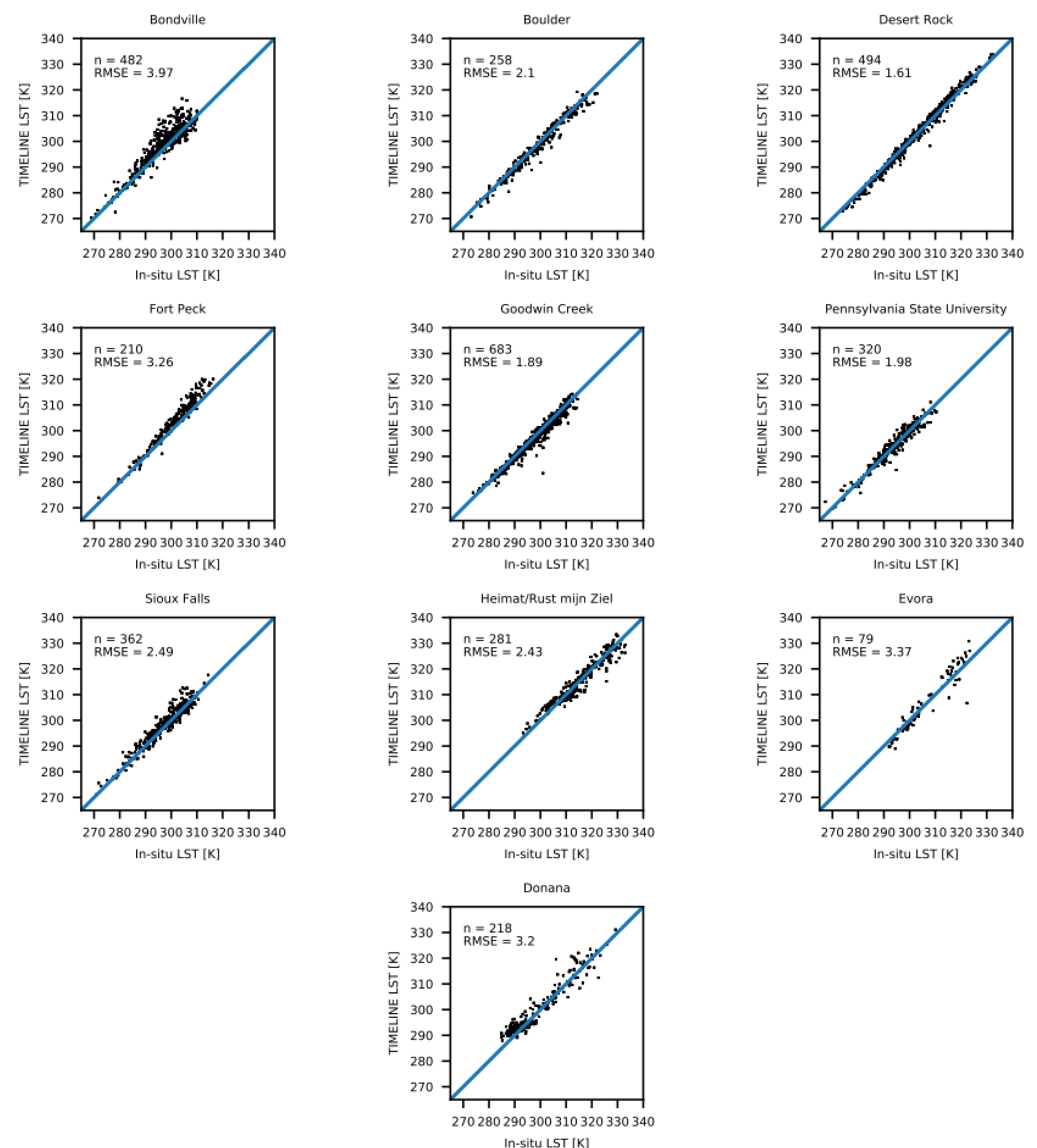


Fig. 3: TIMELINE LST plotted against in situ LST at Bondville, Boulder, Desert Rock, Fort Peck, Goodwin Creek, Pennsylvania State University and Sioux Falls (SURFRAD), Heimat/Rust mijn Ziel and Evora (KIT) and Donana (GCU). The matches have been quality checked and filtered for LST homogeneity (<2 K in a 3x3 window).

In total 3168 quality checked and filtered matches between TIMELINE LST and in situ LST were investigated. The comparison resulted in RMSEs between 1.61 K at Desert Rock and 3.97 K at Bondville and a **mean RMSE** for all sites of **2.83 K**. Thereby TIMELINE LST has a tendency to overestimate at high LST levels and underestimate at high sensor view angles.

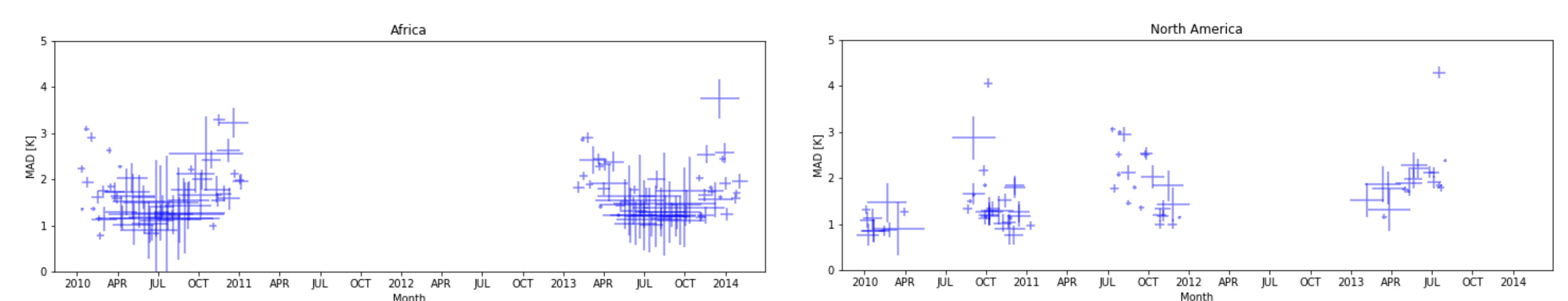


Fig. 4: MADs[K] between TIMELINE and MODIS LST for each overlap over Africa and North America plotted against the AVHRR scene acquisition time. The size of the symbols represents the number of pixels in each overlap.

The comparison with MODIS LST showed a high seasonal variance with **MADs** between **1 K** and **2 K** in the winter months and **2 K** and **3.5 K** in the summer months. Besides that, a clear positive bias of TIMELINE LST towards MODIS LST became visible.

## Conclusion

TIMELINE LST showed a accordance with in situ and MODIS LST in the range of **1-3.5 K**. Larger errors become visible at high LST levels. Current assessments include the extension of the validation to longer LST time series (including AVHRR-1 data) in order to get a conclusive accuracy estimate of the TIMELINE LST product for all land cover types and NOAA platforms.

Website: [www.timeline.dlr.de](http://www.timeline.dlr.de)

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